Measurement of arterial stiffness with a bioelectrical impedance technique

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Résumé en anglais

Introduction: Stiffening of the aorta and large arteries is a functional and structuralconsequence of aging and arteriosclerosis. Pulse wave velocity (PWV) is related to the elasticity of the arterial wall and has been reported as a reference method for measuring arterial stiffness. Bioelectrical impedance (BI) is a well-known noninvasive technique to measure instantaneous blood volume changes from the large arteries and cardiac output. At present, this technique has never been utilized to evaluate stiffening of the large arteries (i.e. Aorta). The purpose of this pilot study was to determine the accuracy of BI as a potential method to evaluate large artery stiffness. Methods: Measurements were performed in 20 patients at rest (mean age: 45years ± SD14). The bioimpedance signals were recorded (Physioflow, Manatech Biomedical) with surface electrodes at the aortic and femoral segments. Cardiac cycles from a 2 minute measurement period were recorded at each site. The delay (in ms) between the R-wave and the first derivative of the impedance signal was calculated after appropriate filtering. Distance between the recording electrodes was measured to calculate the propagating velocity of the impedance wave signal (IWV) between the recording sites. Reference values for pulse wave velocity were assessed by a tonometric technique (PulsePen, Diatecne, Italy) in the same subjects. Results: A linear relationship was found between the two techniques ($r = 0.863$, $P < 0.001$, IWV (in m/s) = 0.850*PWV-0.530). Bland Altman analysis showed a systematic bias of 1.703 m/s with a limit of agreement from -0.593 to 4.001 m/s. Moreover we have shown, in a previous study, that the IWV measurements are reproducible. The bias could be explained by differences in the propagative properties of the impedance wave (i.e. Flow) compared to the mechanical propagation of the tonometric pulse wave along the arterial wall. Conclusion: These preliminary data shows that IWV is fairly correlated to the tonometric PWV reference technique despite some discrepancies. These data suggest that arterial stiffness of the large arteries (aorta and femoral) could be reliably estimated using a bioelectrical impedance technique.

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